HIPPOCRATES

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ON INTERCOURSE AND PREGNANCY

AN ENGLISH TRANSLATION OF

ON SEMEN AND ON THE DEVELOPMENT OF THE CHILD BY TAGE U. H. ELLINGER, SC.D.,M.A.

WITH AN INTRODUCTION BY

ALAN F. GUTTMACHER, M.D.

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ΕΛΕΝΗΙ ΕΨΧΑΡΙΤΙ

CONTENTS

AMONG the seventy titles which together form the book collection known as the *Hippocratic Corpus*, the two which here for the first time are presented in an English translation, *On Semen* and *On the Development of the Child*, are of extraordinary interest. The text presents, in fact, the earliest preserved manuscript of a treatise on the physiology of reproduction, human embryology, heredity and allied topics, including a remarkable digression into the fields of plant growth and soil science (chapters 22-26).

Besides offering a comprehensive presentation of the state of knowledge and of the ideas prevailing at the Greek medical schools of this time, the lecturer gives us an insight into early attempts to develop a scientific method based on analogies, a method even extended into the field of experimentation with phenomena deemed analogous to those actually under investigation. The directions for laboratory work in chick embryology (chapter 29) sound distinctly modern. Most remarkable from a historical viewpoint is perhaps the presentation (chapters 3 and 8) of the Pangenesis hypothesis twenty-three hundred years later associated with the name of Charles Darwin. When this ancient text was called to his attention, Darwin on March 6, 1868 wrote to Dr. William Ogle:

Dear Sir,

I thank you most sincerely for your letter, which is very interesting to me. I wish I had known of these views of Hippocrates before I had published, for they seem almost identical with mine—merely a change of terms—and an application of them to classes of facts necessarily unknown to the old philosopher. The whole case is a good illustration of how rarely anything is new.

Hippocrates has taken the wind out of my sails, but I care very little about being forestalled. I advance the views merely as a provisional hypothesis, but with the secret expectation that sooner or later some such view will have to be admitted.

. . . I do not expect the reviewers will be so learned as you: otherwise, no doubt, I shall be accused of wilfully stealing Pangenesis from Hippocrates,—for this is the spirit some reviewers delight to show.

The author of *On Semen* and *On the Development of the Child*, however, is not the

great Hippocrates of the Cos Medical School. Modern scholars are unanimous in this verdict, and usually ascribe the treatise to a physician of the Cnidian School, the rival of that of Cos.[1] In his views the author seems strongly influenced by the philosophy of the fifth century B.C. Especially noticeable is his dependence on Empedocles and Diogenes of Apollonia.[2] The book, eloquently written and distinguished by the clarity of its presentation, probably was composed at the end of the fifth century B.C. It may reproduce a lecture given by the author, but this is not certain. Together with other medical writings of the classical period it may have come to Alexandria anonymously and may subsequently have been associated with the name of the great Hippocrates.[3] At any rate,

throughout the centuries it was preserved as part of the so-called Hippocratic writings. The text, copied and recopied by hand for some two thousand years, was printed over and over again since the Renaissance. It is now available in Littré's splendid edition of the works of Hippocrates.[4]

It is not without embarrassment that I affix my name to this translation because I could never have done it alone. Whatever merits it may have is largely due to the many delightful hours spent on the manuscript together with Arnold Post, Professor of Greek in Haverford College and Dr. Ludwig Edelstein, at the time Associate Professor of the History of Medicine at the Johns Hopkins University. The reason these colleagues have declined to have their

names appear on the title page, I can only attribute to a most generous view that the initiative in undertaking this work should be given preeminence rather than the actual execution by the joint efforts of a small group of fellow enthusiasts for ancient Greek science.

Dr. Alan F. Guttmacher, Associate Professor of Obstetrics at the Johns Hopkins University, who has taken an enthusiastic interest in this translation, very kindly helped us with a series of medical notes which, with his generous permission, are included in this volume as an appendix to which references are made by numerals in the text.

U. H.

University of the
Philippines, July, 1950.

NOTES

[1] Cf. J. Ilberg, Die Ärzteschule von Knidos, Berichte der Sächsischen Akademie der Wissenschaften, Phil.-hist.Klasse, 76 (1924), 3. Heft.

[2] Cf. O. Regenbogen, Eine Forschungsmethode antiker Naturwissenschaft, Quellen und Studien zur Gesch. der Mathematik, Abt. B I (1930), pp. 173 ff; the author also discusses the importance of the treatise for the history of the experiment.

[3] For the literature on this question, cf. L. Edelstein, the Genuine Works of Hippocrates, Bulletin of the History of Medicine, VII (1939), pp. 236 ff. A somewhat different view is upheld by W. H. S. Jones, "Hippocrates" and the Corpus Hippocraticum, Proceedings of the Brit. Academy, XXXI (1945) (separate edition).

[4] Oeuvres Complètes d'Hippocrate, VIIC, Paris, 1851, pp. 470-542.

THE scholarly translation of any Hippocratic work for the first time into English merits attention. This is particularly true when the text consists of such extraordinary books as "On Semen" and "On the Development of the Child."

Whether their author was the great Hippocrates of Cos, or as most believe a physician from the rival Cnidian school, is of great academic interest, but not of prime importance. The important fact is that these two books give

a clear statement, by a preeminent scientific intellect of the fifth century before Christ of the theories then held of reproduction, embryology and heredity. These two books codify and summarize for that antique Socratic period knowledge comparable to that found in similar twentieth-century authoritative texts: Allen's "Sex and Internal Secretions," Arey's "Developmental Anatomy" and Gates' "Human Genetics."

It is difficult to read with full intellectual tolerance this early Greek author's fanciful seeming ideas so intimately intermixed on the same page with brilliant observations. The scientifically indoctrinated reader is prone to employ an unfair yardstick—is it correct, is the theory or observation judged valid today? Yet

when one considers the ideas of the immediate antecedents and contemporaries of the author of "On Semen" and "The Development of the Child" he becomes not only tolerant but highly respectful.

From the knowledge which has come down to us, Egyptian medicine was disinterested in embryology. This, in spite of the fact that the Egyptians discovered the artificial incubation of bird's eggs thousands of years ago. In contrast to the lack of speculation among the Egyptians, almost all of the pre-Socratic Greek philosophers had opinions upon embryologic phenomena. Yet compared to the opinions and observations found in Hippocrates, Needham in his "History of Embryology," states these earlier opinions "do not really amount to

much." Needham claims that the author of the Hippocratic treatises translated here "could with considerable justice be referred to as the first embryologist." Here then the English reader is privileged to explore for the first time the very fountainhead of embryologic theory and observation. The contents of these books have equal interest for the biologist, the student of philosophy and the physician. For their translation we owe Dr. Ellinger a great debt.

Alan F. Guttmacher, M.D.

1

LAW governs everything. The man's semen comes from all the fluid that is in the body, being the separation of what is most potent. Here is an illustration in proof that it is a separation of the most potent part. The discharge of such a small quantity in intercourse makes us weak. This is the way of it. Veins and cords lead from every part of the body into the penis; when these are somewhat affected by friction and are heated and filled, a kind of tickling sensation sets in and consequently

pleasure and warmth pervade the whole body. As the penis is rubbed and the whole person is agitated, the fluid in the body is heated, diffused, and churned by the movement and becomes foamy as all other fluids too become foamy by churning. So too in man, the most potent and fattest part is separated from the fluid as it foams and passes into the spinal cord for there are passages that lead into it from every part of the body, and there is a circulation of matter from the brain to the loins, to every part of the body, and to the spinal cord, and there are passages leading from the cord such as to permit a flow and ebb of fluid into it and out. When the semen once has arrived at this cord, it passes to the kidneys, for there is a passage through veins; and in case of a sore in

the kidneys it sometimes happens that blood also flows with the semen. From the kidneys it passes through the interior of the testes to the penis, not where the urine passes, but there is another adjoining passage for it. As to nocturnal emissions, their cause is this. When the body fluid has been diffused and heated either by fatigue or through any other cause, it becomes foamy; and when the separation is produced from the fluid, there appears to his vision a woman, the same * as in intercourse, because the condition of the fluid is the same as in intercourse. But I am not concerned with emissions in dreams, neither with the nature of the disorder in general, nor with its effects, nor why it occurs before the experience ** of intercourse. That is what I have to say on this topic.

* Reading οἵη περ.

** Of course what is meant, before the young male has ever experienced actual coitus.

2

Eunuchs cannot have sexual intercourse because the passage of the semen is destroyed in them; for that passage goes through the testes themselves, and delicate and close-packed cords connect the penis with the testes and they are its means of erection and detumescence which are cut in castration. Hence eunuchs are not in a condition to be competent. In the case of those in whom these parts are crushed, the passage of the semen is blocked, for the testes are calloused, and the cords, which have become hard and inert by the callosity, can neither contract nor relax. Persons who have been subjected to incisions

next to the ear do indeed copulate and discharge, but their discharges are scanty, weak and infertile; the reason is that the greater part of the semen passes from the head alongside the ears to the spinal cord; however, that passage becomes hardened by the scar that arises from the incision. In boys, the character of the veins, which are minute and closed up, prevents the semen from moving, neither does the tickling sensation occur in the same way; hence the fluid of the body is not churned so as to separate the semen. For the same reason menstruation does not occur in girls as long as they are young. But when the boy and girl get older, the veins which lead into the penis of the boy and to the womb of the girl become free-flowing with growth and are dilated, and there

is movement and circulation in the narrow passages; and then the fluid gets churned, for it then gains space in which to be churned. This is the reason why there is a flow when the boy is matured and why the girl menstruates. This completes my statement on this point.

3

I maintain that semen is separated from every part of the body, from the solid parts as well as from the soft parts and from every fluid that is in the body. There are four kinds of fluid, the blood, the bile, the water and the phlegm. For that is the number of kinds a man has in him congenitally, and it is these that give rise

to diseases. I have also given an explanation of these fluids, and also why diseases or recovery from diseases are due to them. This is what I have to say about semen, whence it flows and how, and why, in whom it does not flow and why, also about the menstruation of girls.

4

Now as regards women in copulation, I assert that when the genitals are rubbed and the womb agitated, there occurs in it a sort of tickling sensation, and the rest of the body derives pleasure and warmth from it. The woman has also a discharge that flows from the body sometimes into the womb so that the

womb becomes moist, sometimes outside the womb too when the opening of the womb is wider than it ought to be. She feels pleasure from the beginning of intercourse all the time until the man lets her go; if she is hot for intercourse, she discharges before the man and no longer has the same enjoyment; if she is not in heat, her pleasure ceases with that of the man. The thing is this. Just as, if one pours into boiling water other cold water, the water stops boiling, in the same way the male semen when it is ejaculated into the womb extinguishes the heat and the pleasure of the woman. The pleasure and the heat first flare up when the semen is ejaculated into the womb, and then cease. Just as, if one pours wine on a flame, the flame first flares up and is for a moment increased by

the poured wine, then ceases; in the same way the woman's heat flares up in response to the male semen and then ceases. In copulation, the woman has much less pleasure than the man, but she has it for a longer time than the man. The reason why the man has more pleasure is that the separation from the fluid occurs suddenly in him as a result of a more powerful perturbation than the woman's. Here is another trait in women. If they have relations with men, their health is better; worse, if they do not have them. For the womb becomes moist during intercourse and ceases to be dry; but if it is dryer than it ought to be, it contracts powerfully, and the powerful contraction causes bodily pain. At the same time, by heating the blood and making it more fluid, copulation provides

easier passage for the menstrual discharge; moreover, if the menstrual discharge does not pass, women's bodies become unhealthy. Why they become unhealthy I shall explain in *Diseases in Women*. This completes my remarks on this topic.

5

If after intercourse, the woman is not going to conceive, the semen from both usually passes out at her will.[1] If, on the other hand, she is going to conceive, the semen does not pass out but stays in the womb. For the womb after receiving it and closing keeps it inside, the orifice being clogged * by the sticky fluid; and a mixture is effected of that which comes from

* The passive of *εἱλυσπάομαι* occurs only here in Greek. In this translation it is taken to have a meaning analogous to that of the passive of *εἱλύω*. The usual translation would be 'constricting wormlike.'

the man and that which comes from the woman. If the woman has had experience with childbirth and observes when the semen does not pass out but remains, she will know on what day she conceived.

6

The following is furthermore to be noted. The semen of the woman is sometimes stronger sometimes weaker; the same holds for the man. In the man there is female sperm and male sperm; in the same way in the woman. The male sperm is stronger than the female. For of necessity the male develops from the stronger sperm. And here is another point. If the sperm

that comes from both is strong, a male is born, if weak, a female is born. Whichever prevails in quantity, that is what is born; for if the weak sperm is much more abundant than the strong, the strong is overpowered and, being mixed with the weak, is diverted to female; if the strong is more abundant than the weak, and the weak is overpowered, this is diverted to male. Just as if one were to mix wax and fat using more fat and were to melt the mixture over a fire until it was fluid, the one that predominates is not distinguishable; but once it hardens, then it becomes apparent that the fat predominates over the wax in quantity. Just so it is with the male and the female of the semen.

7

Now it is possible to conclude from what is seen to occur that both in the woman and in the man there is seed both of female and of male. For many women who had given birth to females with particular men have given birth to males when they passed to other men; and these same men with whom the women had been given birth to females, when they came to copulate with other women, begot male offspring; and those who had been begetting male offspring, when they copulated with other women, produced female offspring. This account shows that both the man and the woman have both female seed and male. For in the

case of men with whom they gave birth to female children, the stronger sperm was overpowered since there was more of the weak, and females were born; in the case of men with whom they gave birth to males, the stronger predominated, and males were born. The same man does not always supply either strong sperm or weak, but different sperm at different times. It is the same way with women. It is, therefore, not surprising that the same women and the same men produce both male and female offspring. The same thing is true of the generation of males and females in the case of livestock.

8

And in the semen itself there is some drawn from each part of the body, both the woman's and the man's; and weak semen from weak parts, and strong from strong parts. There is necessarily a corresponding result in the child. From whatever part of the man's body more is contributed to the semen than from the woman's, in the offspring that part is a better likeness of the father; from whatever part more is contributed from the woman, that part in the offspring is a better likeness of the mother. It is impossible for the child to resemble the mother in all parts and the father in none, or the other way round, nor is it possible that it

should be like neither parent in any part. There is of necessity a resemblance in some part to each of the parents, if indeed the sperm passes into the child from both bodies. And whichever contributes more to the likeness, that is, from more parts of the body, that is the one that the child resembles in more parts. It happens sometimes that a daughter born resembles the father in more parts than the mother, and a boy born looks more like his mother than his father. These and so many are the illustrations in proof of what I previously stated, to wit, that both woman and man are capable of providing semen for both male and female offspring.

9

The following also happens. Sometimes small and weak children are born from large and strong parents; if such a thing happens after several other children are born, manifestly the fetus suffered in the womb and the hurt came from the mother, who let some of its nourishment pass out,* the womb being too far open, and for that reason it was born weak; illness in any animal is proportional to its strength. If all the children born are weak, the womb is responsible for it, being narrower than it ought to be; for if the fetus has no room in which to develop, of necessity it will be born small, not having space to match its growth; but if it has

* Reading *παρίει* for *παρῆει*.

room and it does not suffer, the child of big-bodied parents will presumably be big.[2] It is as if one should put into a narrow vessel a cucumber, just after the flower falls, still fresh and attached to the cucumber plant. It will be of the same size and shape as the cavity of the vessel; but if one places it in a large vessel capable of holding a cucumber without greatly exceeding its natural size, the cucumber will be of the same size and shape as the cavity of the vessel because it competes in growth with the cavity in which it is placed. And in general everything that grows has whatever form anyone imposes on it. It is the same way with the child; if it has much room for growth, it will become big; if it has little, it will be small.

10

With regard to the child crippled in the womb I say that it is crippled as a result of a bruise, the mother having received a blow in the region of the fetus, or having had a fall, or having suffered some other violence.[3] If the child is bruised, it becomes crippled in the injured part; if the fetus is bruised too much, the membrane enveloping it bursts and the embryo is destroyed. Furthermore, children become crippled in the following way. If the womb is narrow at the part in which the crippling is produced, it is inevitable that the body moving in a narrow space should become crippled in that part. Just as any tree that does not have

enough room in the ground and is obstructed by a stone or any other object, becomes crooked in growth or else big at one point and small at another, so it is with the child when a portion of the womb is relatively too narrow for the corresponding part of the child.

11

With regard to children of crippled individuals, they are born normal in most cases; for the crippled part has its full quota when the parent is healthy. But if the parent suffers from disease, and if the four congenital fluids which supply the semen do not produce a complete semen but semen with that portion of it weaker

which comes from the crippled part, then it does not seem astonishing to me that the child should be crippled like the parent. This completes this subject. I will now go back to the matter I was discussing.

12

(1)

IF THE semen of the two parents remains in the womb of the woman, it first mixes inasmuch as the woman does not keep quiet; it gathers together and thickens as it warms up.[4] Then it forms air partly because it is in a warm place and partly because the mother breathes. When it is filled with air, the air in the middle of the semen makes itself a passage to the outside through which passage it escapes. When the passage to the outside has been formed for the warmed-up air, new

cold air again flows in from the mother. And it goes on doing this the whole time. For the semen is warmed up by being in a warm place and it obtains cold air from the mother as she breathes. Everything that is heated forms air. The air breaks out and makes itself its own passage and passes out. Of itself, anything that is heated draws into it through the fissure new cold that provides food for it. The same thing happens in the case of any wood or leaves, or of things to eat or drink that are intensely heated. Burning wood will provide an illustration of this, for all kinds of wood will behave in this way, particularly when they are slightly green. They emit air at the cut; when air has passed out, it forms a spiral about the cut; and we always observe this happening. The conclu-

sion then is obvious that the warm air which is in the wood draws into it new cold air to replace it, on which it feeds, and it sends it forth from itself; for if it drew nothing in, then there would be no outgoing spiral of air. For everything that is hot is fed on cold in due proportion; and when the moisture in the wood is heated, it becomes air and passes out. The heat in the wood in passing out draws in new cold on which it feeds. Green leaves also behave in this way when they burn, for they form air; then the air breaks out, makes a passage and passes out forming a spiral; in passing out it makes a noise at the place where the outflow * occurs. When legumes, wheat and fruits are heated, they also form air which makes a fissure and passes out. If these things are full of sap,

* Reading *ἐκπνοήν* 'outflow' for *εἰσπνοήν* 'inflow.'

the emitted air is more plentiful and the fissure is larger. But why make a long story of it. Everything that is heated emits air and in so doing draws in to replace it new cold air on which it feeds. These are the compelling proofs which I advance to show that the semen that is warmed up in the womb forms air and emits it. At the same time it receives air from the mother as she breathes. For when the mother has drawn cold air into herself from the atmosphere, the semen makes use of it; and the semen is warm because, I repeat, it is in a warm place; and at that stage it now forms and emits air. As it becomes inflated, the semen forms a membrane; for the outer part of it extends about it and holds together because it is sticky. Just so, when a loaf of bread is baked, there is

formed on the surface something like a thin membrane; for the bread rises as it is heated and inflated, and where it is inflated the membranous surface is formed. As the semen is warmed up and inflated, it is entirely enveloped in an outer membrane. But in the middle of the semen there is a passage for the air to pass in and out through the membrane. And at this point the thin extension of the membrane is detached and there is very little of the semen in that region; all the rest of the semen forms a rounded mass in a membrane.

13
(2)

I myself have seen some semen which had stayed six days in the womb and which fell out; and it is from the qualities that it in my judgment exhibited at that time, that I now draw my remaining evidence. I shall explain how I came to see a six days old semen. A woman I knew owned a high-priced musical entertainer who kept company with men, and who had to avoid pregnancy so as not to be rated lower. That girl had heard what women say among themselves as to the effect that, when a woman is going to conceive, the semen does not pass out but stays inside. Having heard

this, she marked it and always kept watch. And when she noticed one time that the semen did not pass out, she told her mistress, and the report reached me. And I thereupon told her to jump in such a way that the heels touched the buttocks; she had now jumped seven times when the semen fell to the ground with a plop. And when the woman saw this, she stared at it and exclaimed. I shall tell what it was like.[5] It looked as if someone had removed the outer shell from a raw egg and through the inner membrane could be seen within it the inner liquid. Such was in brief its appearance. It was also red and roundish; within the membrane white thick fibers were visible, enclosed* together with a thick and red, bloodlike fluid; around the membrane on the outside there

* Reading *εἰλημέναι*.

were blood clots; in the middle of the membrane something thin was detached which seemed to me to be the navel, and I thought it provided a means of inbreathing and outbreathing for the semen at the start. From it extended the entire membrane enveloping the semen. That is what the six days old semen that I saw was like. A little later I will describe another test in addition to this one, that will enable anyone who seeks knowledge to see this for himself, as well as a proof that my whole discourse is correct, as far as that is possible for a mortal discussing such a matter. That completes my statement on this subject.

14

(3)

Now observe that the semen is in a membrane and breathes in and out and that its growth is produced by the mother, whose blood descends to the womb. For the menses do not flow when the woman has conceived if the child is going to be healthy; except that there are a few women in whose case there is a slight trace the first month. Moreover, as the blood descends from all parts of the woman's body, it collects all around the membrane on the outside. And as it is drawn in through the membrane together with the breath, it coagulates in the region of the perforation and the detached part and

causes growth of that which will later be a living creature. With the passing of time numerous other enveloping membranes are formed inside the first in the same way in which the first was formed; they also extend from the navel and are mutually interconnected.

15

(4)

When this has taken place, as the blood descends from the mother and coagulates, flesh is formed. From the midpoint of the flesh the navel is attached, through which the embryo breathes and gets material for growth. The reason why the cessation of the menstrual flow

causes no suffering when the woman is pregnant, is that the blood is not agitated by passing off all at once at monthly intervals; but it flows quietly, little by little, painlessly, every day to the womb, and the matter that is contained within the womb is increased. The flow goes on day by day, and not merely once a month, because the semen which is in the womb draws continually from the body as much as it can. It is the same with the breath too. At first there is but little breathing and only a little blood comes from the mother. But as the breathing gradually increases, it gains more power to attract the blood, and more and more blood descends to the womb. The reason why the suffering occurs in women who are not pregnant, when there is no menstrual dis-

charge, is in the first place that the blood in the body is agitated once a month for the following reason, namely, that there is a great difference from month to month both in degree of cold and in degree of heat and the woman's body is sensitive to the differences, being moister than the man's. When the blood is agitated and has filled the veins, some of it flows out, and presumably this is an original natural characteristic of hers, so that if the woman empties herself of blood, she conceives; but if she is full of blood, she does not.[6a] For when the womb and the veins have become empty of blood, then it is that women conceive children; for it is after discharge of the menses that women especially conceive for the reason given. But when the blood is agitated and

separated and does not pass out but goes to the womb, and when the womb does not open, then the womb is heated by the blood that stays there, and causes heat in the rest of the body. Sometimes the womb even dispatches blood into the veins of the body whereby the veins are filled and suffer hurt and produce swellings; sometimes too there is danger that such a condition will cause lameness; and sometimes too the womb crowds the bladder, exerting pressure, shutting it off and causing strangury; sometimes too, when the womb is full of blood, it falls either toward the sides or towards the back and causes suffering; sometimes too the blood remains five or six months and, rotting in the womb, becomes pus. In some the pus passes out through the genitals;

and again in the case of some it becomes like a growth in the groin, and in that case too pus is produced and passes out. And many other evils of this kind attack women when the menses are suppressed.[6b] But why discuss that here. The subject will be treated in *Diseases of Women*. I take up my account at the point where I left off.

16
(5)

When flesh has been formed, then as the matter in the womb is increased, the membranes also grow; and these membranes, especially the outer ones, form cavities. And any blood which

has descended from the mother, and which the flesh by its breathing draws to it, after the growth has taken place and the blood is of no further use, is discharged into the cavities of the membranes. And when cavities have been formed and have received the blood, then they are called the chorion. That is what I have to say on this.

17

(6)

As the flesh grows, it is differentiated by the air, and each kind of substance in it goes to its own kind, the solid to the solid, the spongy to the spongy, the fluid to the fluid; and each thing goes to a place of its own according to

the kind from which it originally came. What came from the solid is solid; what came from the fluid is fluid, and the other kinds are produced in the same way during growth. The bones become hard, solidified by the heat. Moreover, they also ramify like a tree. Both the inner and outer parts of the body also become better differentiated. The head becomes detached from the shoulders; the arms and the forearms from the sides. The legs separate from one another. Cords spread rapidly about the growth of the joints and are self-hardened.* The nose and ears are detached amongst the flesh and become perforated. The eyes are filled with a pure fluid. And the sex of the genitals becomes plain. The viscera become differentiated. Furthermore, there is respiration

* Or perhaps: 'veins spread rapidly about the growing organs and of themselves become hollow.'

through both the mouth and the nose. The abdomen is filled with air, and the intestines, inflated from above by the air, cut off the breathing through the navel and stop it. A passage out is formed from the abdomen and the intestines to the anus; and a passage out into the bladder. Each of these parts is differentiated because of the respiration. All things separate by kinds when they have air blown into them. In fact, if you will attach a pipe to a bladder and introduce through the pipe into the bladder some earth, some sand, and some fine lead shavings, pour in water and blow through the pipe, all these substances will at first be mixed up with the water, and then after a certain time, as air is blown in, lead will go to lead, and sand to sand, and earth to earth; and if one lets

them dry and then tears the bladder open and looks, one will find that in each case like has gone to like. In the same way the semen and the flesh are differentiated, and each kind that is in it goes like to like. That completes this subject.

18
(7)

And now it has become a child; and a female embryo reaches this stage in forty-two days at the most, a male in thirty days at the most. For in general it is within that period of time or a little more or a little less that the parts are differentiated. For the lochial purgation lasts

generally forty-two days when the child is a female—that is the longest and the full term; but it would not involve danger even if purgation were completed in twenty-five days. When the child is a male, purgation lasts thirty days —that is the longest and the full term; but it would not involve danger if it were completed in twenty days.[7] Towards the end, the lochial flux is very scanty; purgation is completed in fewer days in young women, in more in older women. Those women who are having their first child suffer most at childbirth and during purgation; and those who have had fewer children suffer more than those who have had more. The purgative discharges after childbirth occur in women because during the early period (of pregnancy) up to forty-two

days in case of the female (child), up to thirty days in case of the male, very little blood descends for the growth of the child, but from that time the amount increases until childbirth. So it is necessary that the deficiency should be made up by the lochial fluid and that it should flow a corresponding number of days.

Purgation starts as follows in a woman in labor.[8] The woman's blood is agitated and thoroughly heated by the vigorous movement of the child, and agitated blood passes out first; then after the child comes a thick bloodlike serum, and the way for this was opened as for water on a table. Afterward, following that fluid, the lochial discharge flows every day during the period stated, at first amounting to one and one-

half attic cotyle,* or a little more or less, and gradually diminishing until it ceases. The blood comes out like that of a sacrificial victim if the woman is in a healthy condition and is going to remain healthy, and it coagulates promptly. If the woman is not in a healthy condition or is not going to remain healthy, the purge is scantier and looks worse, and it does not coagulate promptly. It is like this. If the pregnant woman has some disease that is not akin to the lochial purge, she dies; and if she has no lochial flow during the first days whether she is healthy at the start or not and the flux then suddenly erupts either by the action of drugs or spontaneously, it will continue making up for the number of days during which it did not flow in the beginning. Now in case the lochial pur-

* cotyle = nearly half a pint.

gation is interrupted, the woman will be seriously ill and in danger of death unless she receives prompt attention and a renewal of the flow is induced. I have included these details to make it clear that the differentiation of the parts in children requires at the most forty-two days in the female, thirty in the male; a proof of which is that the lochial flux lasts at the most forty-two days in case of a female, and thirty days in case of a male.

I shall now for clarity's sake repeat my statement. I assert that there is a compensation, because during forty-two days very little blood comes to the semen in the womb from the woman who has a female offspring, for that is the time during which the parts of the child are differentiated. After that period the blood

comes in greater abundance. Again in the case of a male this occurs correspondingly in thirty days. There is a second proof that this is true. During the first days after the semen has dropped into the womb, very little blood comes from the woman into the womb, but afterward it comes more and more; for if blood came in quantity and a great deal at once, the semen could not have any respiration and would choke by the inflow of much blood. The opposite occurs with regard to the lochial flow; it is strongest during the first days, then it diminishes until it ceases. Many women have lost a male fetus after a little less than thirty days, and the fetus was seen to be undifferentiated; but the males which have been aborted later on at the end of the thirty days were seen to be dif-

ferentiated. When a female is aborted, differentiation of the parts is found according to the reckoning of the forty-two days. Whether the fetus is aborted sooner or later, the differentiation is found to occur in this way both in accord with reasoning and with the irrefutable observations, namely in the case of the female after forty-two days, in the case of the male after thirty.[9] For the miscarriages and the lochial discharge supply the proof of it. The reason why the female fetus coagulates and differentiates later is that the female semen is weaker and more watery than the male semen. According to this reasoning, the coagulation of the female fetus is necessarily later than that of the male, and the lochial purge consequently lasts longer in the case of a female than in that of a

male. I will return again to the point where I left off.

19

(8)

When the child is differentiated * into the various parts, the bones gradually harden and become hollow as it continues to grow. This is caused by the air. Being hollow they draw into them from the flesh the fattest part of the clotted blood. In time the tips of the bones branch again, just as the furthest tips of a tree are last to branch. In the same way the fingers and toes of the child also separate from one another. And again, the nails are formed at the ends of the fingers and toes, for all man's veins

* Omitting the comma after *παιδίον*.

end in the fingers and toes; and the veins in the trunk and in the head are the biggest and next to them the veins of the legs, the arms and the forearms; but in the feet and hands they are finest and densest and most numerous, as the cords also are the finest and densest and most numerous, and the bones are smallest. This is especially so in fingers and toes. Fine and compact nails grow out of the fingers and toes, which have a large number of small bones, veins and cords; and they shut off the extremities of the veins so that they can no longer grow and one does not extend beyond another. Therefore, it is not surprising that the nails, which form the last extremity of the body, are the densest parts, for they derive from the densest things.

20
(9)

At the same time as the nails are formed, the hairs take root on the head. As to the growth of the hairs, it is as follows. They grow longest and most numerous where the epidermis is most porous and where the hair has a due amount of fluid for its nourishment. Also where the epidermis becomes porous later, there the hairs grow later too, namely on the chin, the pudenda and wherever else they grow. For at the age when the semen is formed, the flesh becomes porous as well as the epidermis, and the veins open up more than before. For in boys the veins are tiny and the semen does

not flow out through them. In girls the same holds true with regard to the menses. At the same age a way is opened for the menses and for the semen, and both in the case of boy and girl the pudenda become hairy since the epidermis has become porous and at the same time the hair has the due amount of fluid to nourish it and not too little. The same also holds in the case of the man's beard; the epidermis becomes porous because the fluid from the head passes into it. For sometimes during intercourse and sometimes in the intervening period the hair has a due amount of fluid to nourish it, that is, at any time when a delay intervenes while the fluid is descending from the head, diverting * the flow from the chest to the beard. Here is the evidence in proof that hair grows on the

* Reading ἀποχέων for ἀπ ἐχων.

most porous part of the epidermis. If you will burn the epidermis lightly and merely make a blister and let it heal again, the epidermis will become dense in the region of the scar and it will not grow hair. Those who are castrated in their childhood have neither hair on the pudenda nor on the chin and are smooth all over for the reason that no passage is opened up for the semen, and the epidermis is therefore not made porous anywhere on the skin; for the course of the semen is blocked as I said a little while ago. And women are smooth on the chin and on the body because in intercourse their fluid is not agitated in the same way as the men's and therefore does not make the epidermis porous. As to those who become bald, they abound in phlegm. And in their heads the

phlegm, which is agitated and heated during intercourse, comes in contact with the epidermis and burns the roots of the hair, and the hair falls out. But eunuchs do not become bald because they have no violent movements; in them the phlegm is not heated during intercourse and therefore does not burn the roots of the hair. Gray hairs are produced for the reason that when the fluid within the person has been making its way for a long period of time, the whitest part is separated off and carried to the epidermis; when they absorb a whiter fluid than before, the hairs in their turn become white; and where the gray hairs are, the epidermis becomes whiter than the rest; and in the case of those who from birth have some gray on the head, the epidermis where the gray

hairs are is whiter than the rest, for at that point there is the whitest fluid. Here is another point. Whatever the fluid that the flesh absorbs is like, white, red or black, such is the color of the hair as it grows. That is what I have to say about that topic. I will now go back and take up the rest of my subject.

21

(10)

When the extremities of the child's body have ramified externally and when the nails and the hairs are rooted, then the child begins to move. The time that this requires is three months for a male, four for a female; that is the general rule, but there are children who move before

that time.[10] The male fetus moves earlier because it is stronger than the female as coagulation takes place earlier in the case of the male because it is produced from stronger and thicker semen. When the fetus moves then there are also signs of milk appearing in the mother: the breasts swell, the nipples ripen, but the milk does not flow.[11] In women with dense flesh the milk is later in giving signs of appearing and in coming; in women with porous flesh earlier. I will now state the reason why milk flows. When the womb that is enlarged by the child presses on the woman's belly and the pressure is exercised while the belly is full, the fattest part of the food and of the drink oozes into the omentum and into the flesh. Suppose that someone should oil a skin with plenty of

oil and let it absorb the oil, and then, when absorption is complete, should squeeze the skin, the oil would ooze out as the skin was squeezed. It is the same way with the belly which contains the fat from the food and the drink; when it is squeezed together by the womb, the fat oozes into the omentum and into the flesh. If the woman has porous flesh, she becomes aware of the flow sooner, but in the other case later. Pregnant livestock too become fatter by the same drink and food, if they have no illness. It is the same way with the woman. When the fat is thoroughly heated and is now white, the part of it which is sweetened by the heat coming from the womb is pressed out and goes to the breasts. A little of it also goes to the womb through the same veins, for it is the same

veins or similar ones that go to the breasts and to the womb. When that fluid arrives in the womb it has the quality of milk, and the child gets a little food from it; but the breasts, storing the milk, fill up and swell. After childbirth, since the movement now has been started, the milk goes to the breasts if the child sucks them. This is what happens. When the breasts are sucked, the veins which lead to them become more free-flowing; when they have become more free-flowing, they draw from the belly the fat part and transmit it to the breasts. In fact, in the case of a man too, if he indulges much in intercourse, the veins become free-flowing and attract the semen more.

22

(11)

Here is another point. The nourishment and the growth of the children progress according as food goes to the womb from the mother. And whatever the mother's state of health or illness be, such is also the state of the child.[12] Just so, what grows in the soil is nourished from the soil and whatever the condition of the soil is, such also is the condition of what grows in that soil. For the seed, when it is deposited in the soil, becomes full of sap drawn from it; for the soil contains manifold sap so that it can nourish the plants. When it is full of sap, the seed becomes inflated and swells. That potency

of the seed which is the lightest is forced by the sap to condense. After this condensation by the air and by the sap, the potency turns into leaves and bursts the seed. It is the leaves which first spring from the ground. And when they have sprung up, as soon as they are no longer able to obtain nourishment from the sap that is in the seed, then the seed and the leaves crack open below. Forced by the leaves, the seed releases downward such of its potency as remains behind because of its weight, and roots are produced extending out from the leaves. By the time when the plant is firmly rooted below and is deriving nourishment from the soil, the whole seed has disappeared and has been used up in the plant except the seed coat, which is the most solid part. Later, however, the seed

coat rots away in the ground and vanishes. In time some of the leaves form shoots. Having grown out of a seed, that is from a moist source, the plant cannot produce its fruit as long as it is tender and succulent with an impulse to grow both upward and downward; for it has no strong and fat potency in it out of which the seed can be condensed. But when with time the plant has taken on more solidity and has become rooted, at this point it also acquires wide vessels leading both upward and downward; and from then on it no longer sucks watery sap from the soil, but nourishment that is thicker and richer and more abundant. This is now heated by the sun, breaks out at the extremities, and becomes a fruit of the same kind as that from which it was generated. And much

comes from little for this reason, because each plant draws more potency from the soil than that from which it was generated. And the breaking out takes place not at a single point but at many. When the fruit has broken out, it is nourished by the plant; for the plant absorbs nourishment from the soil and distributes it to the fruit; and the sun ripens and solidifies the fruit, drawing to itself the more watery part of the fruit. This completes my account of plants that grow from seed, getting their potency from earth and water.

23
(12)

With regard to plants derived from cuttings, trees are produced from trees in the following way. The cutting has a wound at the lower end that is in the ground, namely where it was broken from the tree, and it is from this wound that the roots are sent forth. They are released in the following way. When the plant that is in the ground has obtained sap from the soil, it swells and forms air within; but the part above the ground has none as yet. When the air and the sap have condensed the potency that was heaviest in the lower part of the plant, it bursts out downward and tender roots grow from it.

When the plant has taken hold below, from then on it derives sap from the root and transmits it to the part above the ground. In its turn the upper part swells and forms air within; and the light potency that is in the plant condenses and grows up forming leaves; and from then on growth takes place both upward and downward. Thus the course of development is opposite in the case of plants that spring from seeds and those that are propagated from a cutting. From the seed it is the leaf that emerges first, and afterward the roots are sent downward while the scion first forms roots, then leaves. Here is the reason. In the seed itself there is an abundance of sap; and as it is entirely in the ground, there is from the start sufficient nourishment for the leaf to feed on

until the roots are formed. In the cutting this is not the case, for such a cutting is not generated from something else on which the leaf can feed from the start. But the cutting itself is in the same position as a tree, and a tree is largely above ground so that it could not be filled with sap above ground unless a great deal of potency were to come from below as a source of sap for the upper part. And it is first necessary for the scion to procure food for itself from the soil by means of its roots and then, drawing it in this way from the soil, to transmit it upward, until leaves begin to sprout and grow.

24
(13)

As the plant grows, it is forced to branch out in the following way. When more sap drawn from the ground is added to it, then, because of the amount of it, it makes a crack where there is most sap; and at that place the plant forms branches. And it grows both in width and in height and in depth because the ground below is warm in winter and cold in summer. That condition is due to the fact that the soil is full of sap in winter because of the water that falls from heaven and is pressed down upon itself because the sap weighs more. Consequently it is denser and has no respiration; it no longer

possesses any great porosity and as a result the subsoil is warm in winter. For stacked manure is also more subject to heating than when it is loose. And in general things which are moist and compressed heat up by themselves and decompose quickly being burned up by the heat; for the air does not pass through them because they are dense; but when they are dry and placed loosely, they heat up much less and decompose much less. In the same way wheat and barley are more subject to heating when they are moist and packed tightly than when they are dry and resting loosely. Clothes which are fastened together and strongly wedged down with a bar are consumed spontaneously as if they had been set on fire, as I have myself seen. And if one will also call to mind other things

that are self-compressed, one will find them hotter than those which rest loosely. For they can breathe in no cold air from the winds. So too when the subsoil is saturated and self-compressed it becomes warm in winter inasmuch as it is heavy and dense with moisture, for there is no exhalation of the heat; but when water falls on it from heaven and when evaporation takes place in the earth from the water, the vapor does not move far because of the density of the soil; but it returns back into the water. It is for this reason that springs are warmer and fuller in winter than in summer; the exhaled vapor returns back into the water because the soil is denser and does not permit the vapor to pass through it. The water, being plentiful, breaks a place for itself wherever it can and

makes a wider course for itself than if the water were but scanty. For water does not stand still in the earth but always flows downhill. If the soil let the vapor from the water pass through it in winter, a less amount of water would flow from it, and springs would not be swollen in winter. I have stated all this to show why the ground below is warmer in winter than in summer.

25

(14)

Now I shall show why the ground below is cooler in summer than in winter. In summer the earth is loose and light because the sun strikes it with more force and attracts moisture

from it to itself. The soil always contains more or less water in it. Moreover, all winds come to us from water. One may conjecture that this is so in the following way. Winds always come from all rivers and from clouds. Clouds are water that is massed together in air. Then in summer the soil is loose and light, and holds water. The water runs downhill; but as the water flows, vapor after vapor rises from it layer upon layer. The vapor that rises passes through the soil, which is light and loose, and makes the ground cool; and the water is cooled along with it. It is as if one were to exert strong pressure on water that is in a skin and make a vent for the water by pricking it with a needle or some slightly larger instrument and were to hang it up and swing it. No vapor will come

out of the opening but only water; for the water has no room to produce an exhalation. So it is also in winter with water in the soil. But if you make room for the water in the skin, hang it up and swing it, vapor will come through the opening; for the vapor that rises from the water in motion has room to move within the skin; and that is why vapor comes out of the opening. So it is also in summer with water in the ground; it has room because the ground is loose and the sun draws the moisture from it to itself. It is by letting the cold vapor from the water pass through soil that is loose and light that the ground is cool below in summer. The water is the cause of the cool vapor in the soil, and it sends forth the vapor into itself and into the soil. Then too drawing water

from a well constantly stirs the vapor as a fan does and makes it convey coolness to the water; but water from which none is drawn in summer and which remains stagnant does not, because of its density, in the same way receive the vapor from the soil; neither does it give off vapor to the soil. Then too the water derives warmth from the sun and from the air in the well, which is not moved about but motionless—first the surface, then layer after layer transmitting the heat downward. That is why water from which none is drawn in summer is warmer than water from which some is drawn. Very deep springs are always cold in summer. Water drawn in winter is at first warm because the ground is warm; later after a certain time it is cold, evidently under the influence of the air,

which is cold. For water is evaporated by the wind, and the vapor circulates through it. In the same way the water which is drawn in summer is cold when it is drawn but later becomes warm. Here is the reason. It is cool because the soil is loose and there is vapor in it; but when some time has passed since it was drawn, it becomes stagnant and is observed to be warm. For it is heated by the air which is hot, just as the water in the well from which none is drawn becomes hot in summer for the same reason. That is what I have to say on this topic.

26

(15)

I shall repeat again. In summer the ground below is cold; it is warm in winter; it is the opposite with the top soil. Now it is needful that the tree, if it is to thrive, should not at the same time have either two kinds of heat or two kinds of cold. Rather, if warmth comes to it from above, it is necessary that cold should come to it from below; and again, if cold comes to it from above, it is necessary that warmth should come to it from below. The roots transmit to the tree whatever they absorb, and so does the tree to the roots. In that way a regulation of coolness and warmth is effected.

Just as in man, when food has been taken into the stomach which while digesting produces heat, the heat should be counterbalanced by cold coming from drinks, so also in the tree there should be a compensation from below upward and back again. The tree grows upward and downward because it receives nourishment both from below and from above. As long as it is very tender, it does not bear fruit, not possessing the fat and dense potency which is capable of contributing to fruit. But when some time has elapsed, then the veins as they dilate make the sap flow abundant and rich from the soil. The sun diffuses the sap, and since it is now light, makes it break out in the extremities and produce fruit. It carries the thin sap off from the fruit and makes the thick sap sweet

by cooking and heating it. Trees which do not bear fruit have insufficient fat in them to distribute to the fruit. When with time the whole tree is hardened and has now taken a firm hold below with its roots, it stops growing in any manner. As for buds taken from one tree and inserted in another, which having become trees on trees live and bear fruit different from that of the tree in which they are inserted, this is how it happens. First the bud grows, for it had nourishment at first from the tree from which it was removed, but has it later from the tree on which it was grafted. When once it grows in this way, it sends minute roots from itself into the tree; and at first it feeds on the sap that is in the tree on which it is grafted. Afterward with time it extends its roots all the way to the

soil through the tree on which it was grafted and feeds by drawing sap from the ground and gets its nourishment from that source. Consequently one must not be surprised to see grafts bear fruits different from their trees, for they live from the ground. I have presented these details on trees and fruits because it was impossible to leave this subject half completed.

27
(16)

Now I return again to the subject for the sake of which I have made my statements about these matters. I say that all things that grow in the soil live on sap from the soil, and whatever

is the state of the soil with regard to sap in it, such is also the state of the things that grow. In the same way the child in the womb lives on food from the mother; and whatever is the mother's state of health, such is also the state of the child's. If one will consider from the beginning to the end what has been said about these matters, one will find that the growth of what grows out of the soil is altogether similar to the growth of what grows out of man. This is what I had to say on this point.

28
(17)

The child in the womb has its arms near the knees and its head near the feet.[13] There is no way of deciding accurately, not even if one could see the child,[14] whether the head is upward or downward. The membranes which support it extend from the navel.[15]

29
(18)

Now I shall recount the crucial test, that I promised a little while ago to make known,

which is as clear as possible to a human intelligence and makes plain to anyone who wants to be informed about it, that the semen is in a membrane and that the navel is in the middle of it, and that it first draws air in and expels it outward, and that there are membranes from the navel. You will also find the further growth of the child, as I have described it, to be, from beginning to end, such as it is in my account, if you will apply the methods of inquiry that I am about to describe. Take twenty eggs or more and give them to hatch to two hens or more; then on every day from the second to the last, that of hatching, remove an egg, break it and examine it. You will find that everything in it conforms with my statements, in so far as one can compare the growth of a bird with that of

man. That there are membranes extending from the navel, and all my other statements about the child, you will find illustrated from beginning to end in the hen's egg; and he who has not yet made these observations [16] will be surprised that there is a navel in a hen's egg. Such are the facts, and such is my account of them.

30

(19)

When the time of delivery comes, then the child by moving and by striking out with hands and feet breaks one of the interior membranes.[17] When one is broken, from then on

the others too have less strength, and they break. First the membranes which come next in order until finally the outermost of them is reached. When all of the membranes have burst, the embryo is freed from its attachment and comes wriggling out. For the attachment has not the strength to hold it longer when the membranes give way; and when they are swept away, neither can the womb longer retain the child. When the membranes envelop the child, they are indeed attached to the womb, but not very firmly.[18] When the child begins to move, it forces its way and dilates the womb during the passage, because the womb is elastic. It moves head first if it proceeds naturally, for its upper parts as measured from the navel are the heaviest. When it is in the womb, it usually be-

comes strong enough to break the membranes in the tenth month, when the time of delivery approaches for the mother. But if the child suffers some violence and the membranes are broken, it will come forth before the fixed time.[19] If the nourishment that it derives from the mother fails the child earlier, in that case too there is an earlier delivery, and the child passes out in less than ten months. As regards all those mothers who have supposed that they had carried a child more than ten months, for I have often heard this reported, those mothers were misled in the following way, as I shall explain. When the womb takes in air coming from the belly, which is a source of inflation, and the womb swells, for that happens sometimes, then the women believe that they are

pregnant; or if the menses do not flow but gather in the womb and that continues for some time, then there is a constant flow into the womb sometimes accompanied by air coming from the belly, but sometimes too heat is generated, and so in that case too the women imagine that they are with child since the menses are suppressed and the womb swollen. Furthermore, it happens occasionally that the menses either burst forth spontaneously or because new menses descend from the body to the womb and sweep the first with them, and the inflation passes out. It has then happened in many cases immediately after the purgation of the menses that the womb has been wide open and turned to fit the penis, and at that moment such women had intercourse with

men and conceived the same day or a few days later. But women who are not informed of these theories and of these facts estimate that they were pregnant during the period the menses were suppressed and the womb swollen.[20]

I shall now relate why pregnancy does not last more than ten months. The nourishment and the material for growth that descend from the mother are no longer sufficient for the child when ten months have passed and the embryo has grown. For it absorbs the sweetest part of the blood and also gets a little food from the milk. But whenever these sources become inadequate for it and the child is full-grown, it craves more nourishment than actually is available, and so strikes out and bursts the membranes. Now women in their first pregnancy are

more affected than others by this condition, for in their case there is insufficient nourishment for the children to last for the ten months. There is insufficient food for the following reason. There are women in whom the monthly purge is adequate and others in whom it is too scanty. If this always happens, it is a natural and generic trait inherited from their mothers. But those who have a scanty menstrual discharge, they too supply too little nourishment for the children towards the end of the period when they are now full-grown, and so cause them to strike out and be in haste to come forth before the ten months; for blood comes from the mother in too small amount. Generally also the women who have a scanty menstrual discharge are more liable to have no

milk; they are very dry and of compact flesh.

Now in proof of my theory, that it is the lack of nourishment that causes the child to come forth, provided it suffers no violence, I offer the following evidence. The bird develops from the yolk of the egg in the following way. Under the brooding mother the egg is heated and the content of matter inside receives the impulse to development from the mother. When the content of the egg is heated, it forms air and attracts other cold air from the atmosphere through the egg; for the egg is porous enough to admit the attracted air in sufficient quantity to the matter inside. The bird grows in the egg and is differentiated in the same or in a similar way to the child, as I have already said above. It develops from the yolk, but it receives its

nourishment and material for growth from the white that is in the egg. This was at once apparent to all those who have given attention to it. Whenever nourishment from the egg is insufficient for the chick, then, not having sufficient nourishment to live on, it moves violently in the egg seeking more nourishment, and the membranes about it burst. When the mother notices that the chick has moved violently, she pecks and removes the shell. And this happens in twenty days. And it is evident that this is so for when the mother pecks the shell of the egg, there remains in it no liquid worth mentioning, since it has been expended on the chick. In the same way when the child completes its growth in the womb, the mother can no longer supply sufficient nourishment. Since accordingly the

embryo seeks a greater supply of food than it has, it strikes out and bursts the membranes and, freed from the attachment, at the same moment proceeds to come forth. That happens in ten months at the most. In the same way in the case of livestock and wild animals there is a period for each kind within which birth occurs, which is not exceeded; for of necessity there is for each kind of animal a time within which the nourishment will become insufficient for the young and will fall short, and the birth will occur. And those who have less nourishment for the young give birth earlier; those who have more, later. That is what I have to say on this subject.

With respect to the child when the enveloping membranes have burst, then if the down-

ward pull of the head prevails, the woman has an easy delivery. But if the presentation is sidewise or feet first, as will occur if the child happens to fall that way, either because of the width of the womb or because the mother did not at once become quiet when her labor began —if, I say, the presentation is like that, then the woman will have a difficult delivery.[21] Many mothers have either died themselves, or their children have perished, or mother and child together. Of women who give birth those in their first delivery suffer most, because they have no experience of that kind of pain. They suffer in the whole body but especially in the loins and in the hips, for the hips are thrust apart. But those who have more experience of delivery suffer less than those in first delivery,

and those who have given birth several times suffer very much less.[22] If the child moves head first, the head comes out first and then the other parts follow, and last the navel. The placenta is connected with the navel. Afterward there flows from the head and the rest of the body a bloodlike watery discharge, which is forced out by the pressure, the effort, and the heat, and opens the way for the lochial flow. After the discharge of this serum, purgation continues for the previously stated period. The breasts and other parts where fluid is plentiful in the women collapse, least in the first delivery, but as the deliveries they experience become more numerous, the collapse is greater and greater, as the veins are emptied by the lochial discharge. This is what I had to say on this.

31
(20)

Twins are born from a single act of intercourse in this way.[23] The womb has numerous and curved cavities, some further from, others closer to the genitals. Animals which bear many young have more cavities than those that bear few. It is so in sheep, wild beasts and birds. When the semen happens to be divided by arriving in two cavities, and when the womb has received it and neither cavity lets the semen flow into the other, then the semen surrounds itself with a membrane in each cavity and gains life separately in the same way as has been stated in the case of a single embryo. That

twins come from a single coitus is proved by the fact that the bitch, the sow, and other animals give birth to two or more young by a single breeding; and each of the young occupies a cavity in the womb and has a membrane.[24] Of these occurrences we are ourselves witnesses, and the young are usually all born on the same day. In the same way, in the woman the twins produced by a single coitus have each a cavity and a membrane, and she gives birth to both on the same day and one of the two passes out first with its membrane. That twins can be both male and female is, I maintain, because in the woman, in the man, and in every single animal there is weaker semen and stronger semen; and the semen does not flow in a single spurt but is ejaculated two

or three times. Neither is it possible that it should always be all equally strong, that which comes first as well as that which comes last. Hence that cavity of the two into which the denser and the stronger semen happens to come is the place where a male child is formed. Again the cavity to which more fluid and weaker semen comes is the place where a female child is formed. If strong semen comes to both cavities both twins are male; if weak semen comes to both, both twins are female. Here this whole subject, as I have dealt with it, comes to an end.

By Alan F. Guttmacher, M. D.

1. The role that post-coital loss of semen from the vagina plays in fertility and sterility is unsettled. Without proof of the value of its retention, the modern physician empirically instructs the sterile wife to husband the semen by lying on her back for a half hour or longer after intercourse, raising the level of the hips above the shoulders with a pillow. Yet the therapy is contrary to the scientific data, for it is now presumed that most pregnancies are due to direct intracervical insemination, and that the strictly

vaginal portion of the semen has very short lasting fertilizing ability. The acid contents of the vagina kill the spermatozoa in less than two hours, while the alkaline mucus of the cervical canal preserves their life for twenty-four hours or longer. Obviously the retention or expulsion of semen after intercourse is no guarantee of conception or contraception.

2. There is no obstetrical basis for the belief that the size of the newborn infant is in any way correlated to the size of the uterine cavity. Even encroachment on the uterine cavity by large fibroid tumors seems to have no effect on the normalcy of the fetus or its size. The average smaller birth weight of twins, which the author of *On Semen* could have marshalled in support of his thesis, is not due to crowding

but to the fact that on an average they are born twenty-two days early. Furthermore the placento-uterine blood supply appears insufficient to nourish two fetuses as adequately as one.

3. The severe trauma the pregnant uterus and its fetus can withstand is truly amazing. In the last fifteen years in more than 50,000 cases at the Johns Hopkins and Sinai Hospitals in Baltimore we have seen only two instances in which an abdominal blow had dire consequences. In the first the woman fainted and knocked her abdomen on the point of a stone step, and in the second, she slipped and struck her abdomen on an automobile bumper. In the former instance the baby and woman died from a ruptured uterus, and in the latter, a traumatic

premature separation of the placenta was fatal to the baby. I know of no instance where the fetus itself was injured or malformed by violence to its mother. Even in the two cases cited from our Baltimore experience the fetal death was not primary; it was secondary to a ruptured uterus and a prematurely separated placenta, both producing fatal anoxia from an interruption of the fetal-maternal exchange of oxygen and carbon dioxide.

4. This is the reverse of physiologic fact When first ejaculated, the bulk of the semen is quite thick, containing much solid mucus material, but due to enzymic action is soon liquefied into a homogeneous, watery, slightly viscid fluid.

5. This is a brilliant description of a blood

mole: an early defective ovum partially surrounded by organized, adherent blood clots. In such a defective egg it is not unusual to find a short umbilical cord, the thickness of a piece of string, to which no embryo is attached; its intact chorionic sac distended by blood-stained amniotic fluid. The "high-priced musical entertainer" simply had the good fortune to abort her unwanted pregnancy during the course of strenuous gymnastics. Such activities would never cause the expulsion of a sound, well-embedded pregnancy, but might readily cause the expulsion of an unhealthy, already semi-detached ovum, which would have been aborted within the next few hours or days even if she had remained quietly in bed. It is also obvious to us today that the pregnancy was many times

older than six days. A six day ovum is a barely visible speck to the naked eye of the expert.

6[a]. This is to explain the clinical observation that women with amenorrhoea are almost always sterile. Today we realize that such sterility is usually of pituitary-ovarian origin, not uterine as the Hippocratic author believed.

6[b]. Hematometra, retention of menstrual blood within the uterus because of some obstruction to its egress (imperforate hymen, congenital malformation, cervical scar or tumor) may become secondarily infected and form pus, pyometra.

7. The reasoning that it takes the same length of time to form a child as the lochial discharge flows is ingenious to say the least. The Hippocratic belief that the lochial discharge ordinar-

ily lasts longer after bearing a female infant strikes one as fantastic, yet it had its counterpart in the Old Testament. In Leviticus, Chapter 12, we learn that the period of post-partum purification requires forty days after a man-child and eighty days after a maid-child.

8. With the introduction of the clinical thermometer, and a realization of the value of the pulse as an index of health and disease, a tendency arose to lay less emphasis on the significance of variations in the lochial discharge. This tendency was greatly augmented through the introduction of bacteriology and other laboratory sciences, so that now little attention is paid to this phase of obstetrics. The text books of a hundred years ago had a chapter on the lochia, while text books today dismiss it with a

paragraph. As a rule the flow lessens day by day and becomes continuously paler. Normally it has a non-fetid, fleshy odor. It disappears a little before or after the end of the fourth week. Variations from this normal pattern may indicate infection, retention of placental fragments, subinvolution, etc.

9. As a matter of fact unless the observer is an expert embryologist it is difficult to determine grossly the sex of the embryo until the end of the third month (about 90 days).

10. Fetal movements begin very early, and a fetus removed by abdominal operation may be observed to move its extremities at the end of the third month. However, the movements are rarely appreciated by the woman until the fourteenth week, frequently not until the twentieth

(4½ months). She is likely to feel them earlier in a second pregnancy than in her first, probably due to the fact that she knows what to expect. Despite the author's claim, the male does not move earlier than the female.

11. Beginning with the third month a colorless viscid fluid is often discharged from the nipple. This fluid, colostrum, is the precursor of the milk into which it metamorphoses about seventy-two hours after delivery.

12. No exact parallel exists between the state of the mother's health during pregnancy and the health of her fetus or newborn. Since the fetus is a typical animal-parasite it often thrives, even at the expense of the host. A woman dying of tuberculosis often delivers a robust baby.

13. This would be a very bizarre position for

the fetus to assume. It is a safe rule to state that the living fetus seeks a comfortable position. Ordinarily the head presents over the pelvis with the arms partially flexed in the region of the chest. The back is slightly arched and the breech with legs partly extended is contained in the upper portion of the uterus. Such a position as the Hippocratic author portrays suggests a fetal death in utero. Exact information about the position of the living fetus in utero was unobtainable until the X-ray was introduced.

14. Human dissection was not practiced until a century or two later being introduced and practiced in the third century B.C. by Herophilus and Erasistratus. Therefore perhaps our author meant by the phrase "not even if one could see the child" that the observer simply

gazes at the uterus through an intact abdominal wall. I agree that it would be very difficult under these circumstances to differentiate a cephalic from a breech presentation. For many centuries physicians occasionally distinguished the breech from the head by haphazardly palpating the abdomen. However palpation to define fetal position did not become a routine and reliable technique until 1895 when it was standardized by Leopold into his four manoeuvers. It is now the first obstetrical discipline we teach medical students.

15. The membranes originate from the periphery of the placenta and encase the fetus, but do not fix its position in utero. Of course the only structure coming from the navel is the umbilical cord which is long enough not to

interfere with the movements or positions of the fetus. The structure which actually constrains the fetus is the uterine muscle itself which forms the walls of a gourd-shaped, fluid-filled vessel.

16. The attempts which the early scientists made to create a close analogy between the egg and the chick, and the human uterus and the fetus did much to retard embryology for two thousand years.

17. The idea that the child initiates labor through its own efforts was dogma until the early Seventeenth Century when Fabricius and his distinguished pupil, William Harvey, first observed the contractile powers of the uterus and realized their function. It is difficult to understand how the theory of fetal initiation of

labor could explain the birth of an infant who had died in utero before labor's onset. The belief that the child, like the chick, got tired of its prenatal environment, and just decided to break forth and did so affected medieval therapeusis. If because of a mother's contracted pelvis, a condition which was but dimly suspected until the Sixteenth Century, or some other maternal reason, birth was at a standstill, the doctors felt justified in doing a destructive operation on the living fetus, since they erroneously believed that the infant was behaving in a most uncooperative fashion. Furthermore if the onset of labor was past due, it was considered efficacious by some to smoke the fetus out, like a fox from its lair. A spout was placed in the vagina and the steam from a stinking brew of burnt

feathers, castorium, etc. introduced. This offended the nostrils of the infant and made further residence in the womb objectionable to it.

18. This is a correct anatomical observation. The membranes really are more applied to the inside of the uterus than attached to it.

19. Premature rupture of the membranes is usually followed by the onset of labor within forty-eight hours, though occasionally a much longer period elapses.

20. The explanation that pregnancies which last longer than 280 days are actually miscalculations because of abnormalities in the menses is correct for some cases. However there is little doubt that occasional pregnancies are carried 300 days, or even longer, when calculated from the time of coitus. Thomas Eden, an eminent

English obstetrician, has reported a pregnancy which lasted 336 days after the beginning of the last menses and 315 days from the last coitus.

21. A vertex presentation occurs in 96 per cent., breech in 3.5 per cent., and a transverse presentation (the baby lying cross-wise with the head on one side of the mother's abdomen, the legs on the other, a shoulder or the chest over the pelvis) in one-half per cent. The mother does equally well if the presentation is vertex or breech, although the average labor is a little longer in the latter. The risk is three times greater to the baby in breech presentations, than when vertex. The transverse presentation is very serious for mother and child, and unless treated with intelligence both may die. The

causes for the various types of presentation are sometimes obscure, but it seems hardly likely that any which the ancient author suggests is correct, except perhaps the "width of the womb."

22. The true reason that the multiparous woman (having borne a child before) suffers less than the woman in her first labor is that the cervix and other soft parts once having been stretched apart, dilate more readily and quickly. There is little evidence that any human, female or male, grows accustomed and acquiescent to pain.

23. This is biologically true except in rare instances. Superfecundation, the fertilization of two ova at approximately the same time by separate coital acts, does occur as attested by many observations of women bearing twins

with different racial characters. The first case of human superfecundation reported in America was published by Archer in 1810 when a woman gave birth to twins, one unquestionably white, the other unmistakably mulatto.

24. The author shows great ignorance of the anatomy of the human uterus. This is excusable when one realizes that human dissection was not yet practiced. Anatomy was largely the anatomy of brute animals, almost all of which have a bicornuate, double uterus, in contrast to the single chambered organ of the human. Whether he believed that each pup of the dog's litter occupied a separate uterus, or whether he considered each alternating distended and constricted area of a uterine horn a separate uterine cavity is impossible to determine.